

SWDIV G3000tg

**Site Water & Sanitary Sewer System
Technical Guide**

04/02

**TECHNICAL GUIDANCE
FOR
CIVIL ENGINEERING DESIGN
OF
WATER AND SANITARY SEWER
SYSTEMS**

Prepared By:

SOUTHWEST DIVISION, NAVAL FACILITIES ENGINEERING COMMAND, SAN DIEGO, CALIFORNIA

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Part 1 - GENERAL

1. INTENT: The purpose of this document is to provide technical guidance and outline technical requirements for the more typical aspects of the civil design portion of Design-Build contracts for Southwest Division, Naval Facilities Engineering Command. This Technical Guide specifically describes minimum acceptable standards for design and construction of Water and Sanitary Sewer Systems for Design-Build Projects. The information provided in this guide shall be utilized by civil designers in the development of their portion of the plans, specifications and calculations and shall serve as minimal civil design guidance. This is a guide only and is not intended to cover every situation or restrict innovative design alternatives and good common sense design decisions. Questions or recommendations for improvement of this document should be brought to the attention of SOUTHWESTNAVFACENGCOM.

1.1 GUIDANCE AND DESIGN CRITERIA: Potable water and sanitary sewer design and the associated construction shall meet the requirements of the applicable regulatory agency that governs and issues permits for the installation and operation of these systems.

Part 2 – POTABLE WATER SYSTEMS

2.1 GENERAL INFORMATION: This Section of the Technical Guide refers only to potable water systems. Nonpotable water systems (raw water and sea or salt water systems) shall be addressed on an individual basis.

2.2 DESIGN REQUIREMENTS: In order to properly design potable water services, the engineer shall:

a. Determine the required flow and residual pressure. This information should be calculated based upon the peak demand. Consideration shall be given to fire protection systems, industrial processes, and domestic usage demands.

b. Determine the available flow and the residual pressure at the point of connection. For preliminary planning and/or programming purposes, this information can be obtained from the station Public Works Office or from the Activity Fire Department. For final design, however, the Design-Build Contractor's Architect/Engineer of Record shall conduct flow tests in accordance with NFPA 291. Results of these flow tests shall be included in the Basis of Design and/or Calculations prepared by the Design-Build Contractor's Architect/Engineer of Record.

2.3 SIZING OF MAINS AND SERVICE LINES: Select the smallest pipe that will satisfy all of the following conditions:

a. The residual water pressure at peak flow shall not be less than 2.74 bar (40 psi). Some facilities will have a requirement for higher pressures. The civil engineer shall coordinate this requirement with the mechanical/plumbing and fire protection engineers for the project.

b. If a new automatic fire extinguishing system is being provided, residual pressure shall meet the requirements for activation of the system while simultaneously providing 50 percent of the average domestic and industrial flows.

c. Velocities greater than 3 meters per second (10 feet per second) should be avoided.

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- d. Water distribution mains shall be a minimum of 200 mm (8 in) in diameter.
- e. Minimum pressure at any fire hydrant within the system shall be 1.37 bar (20 psi) at maximum fire flow and peak day demand.
- f. Use per capita water flow rates as determined by the local water agency or appropriate NAVFAC design manuals.

2.4 MATERIAL SELECTION

2.4.1 WATER MAINS: For most installations, water mains 12 inches in diameter and less shall be either PVC pipe (AWWA C900) or ductile iron pipe (AWWA C151). Water mains larger than 12 inches in diameter shall be either PVC pipe (AWWA C905) or ductile iron pipe (AWWA C151). Other materials may be appropriate on certain projects and should be evaluated on a case by case basis. SOUTHWESTNAVFACENGCOM, Chief Engineer approval shall be obtained before specifying materials other than PVC (AWWA C900) or ductile iron (AWWA C151).

2.4.1.1 All ductile iron pipe shall be in accordance with AWWA C151 and have a cement-mortar lining in accordance with AWWA C104. In all coastal areas and in areas where corrosion may be a problem, the ductile iron pipe shall be wrapped in polyethylene in accordance with AWWA C105.

2.4.1.2 All PVC piping used for water mains shall be in accordance with AWWA C900, Class 150 minimum or AWWA C905, Class 235 minimum). PVC piping shall not be used in any aboveground applications.

2.4.2 WATER SERVICE LINES: For most typical installations, water service lines shall be copper tubing (ASTM B88) minimum wall thickness corresponding to type "L", or PVC, and shall be Schedule 40 (ASTM D1785) for pipe sizes up to and including 40 mm (1-1/2 in) and Class 315 (ASTM D2241) for sizes 50 mm (2 in) through 90 mm (3-1/2 in). Service lines of 100 mm (4 in) and 150 mm (6 in) diameter shall be PVC pipe (AWWA C900) or ductile iron pipe (AWWA C151). Solvent welded PVC joints shall not be used above 100 mm (4 in) diameter.

2.4.2.1 All water service laterals (with the exception of fire services) shall be metered. Meters shall conform to the AWWA standard appropriate for the intended water service. Propeller meters shall not be used for billing purposes.

2.5 BACKFLOW PREVENTION: Provide backflow prevention valves, either double check valve assembly type or reduced pressure type, on all commercial, industrial and landscape water service laterals. Install valves within protective metal enclosures. All backflow prevention devices specified must be on the current list of approved backflow prevention devices published by the Foundation for Cross-Connection Control and Hydraulic Research (FCCCHR).

2.6 VALVES AND HYDRANTS

2.6.1 VALVES: Valves shall be installed at all new points of connection and where necessary to insure adequate sectionalization of the water distribution system. Valves shall be placed in protective valve boxes and located outside of pavement and heavy traffic areas whenever possible.

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2.6.2 HYDRANTS: Locate fire hydrants in accordance with the requirements of MIL-HDBK-1008, latest series. Provide a 150 mm (6 in) minimum diameter valved service connection to each fire hydrant. Verify thread requirements with Activity Fire Department.

2.6.3 POST INDICATOR VALVES: Provide post indicator valves and backflow prevention valves on all fire service laterals. Valves shall be located one to two meters from pavements and arranged to be visible from the fire access lane.

2.7 SYSTEM LAYOUT: The layout of the water systems shall minimize the lengths of new lines while providing the best hydraulic solution to the project. Distribution systems should be looped as much as possible. Only one (1) fire hydrant is allowed on a non-looped water main. Provide adequate thrust restraint. Minimum cover should be 0.9 m (3 ft). In locating mains and service lines consider the following as minimum guidelines and comply with the requirements of the local health department regarding water and sewer separation:

- a. Water lines shall be clear of all structures, adjacent to and parallel to streets, and where possible out of roadways.
- b. Water lines shall be laid in trenches separate from sewer lines, and above and at least 3 m (10 ft) away from nearby sewers; preferably on the opposite side of the street.
- c. Where a sanitary sewer crosses over a water line, the portion of the sewer line which is within 3 m (10 ft) of the water line (on both sides) shall be of pressure pipe or encased in at least 200 mm (8 in) of concrete.

Part 3 - SANITARY SEWER SYSTEMS

3.1 GENERAL INFORMATION: This document refers only to the collection system for domestic wastewater. Industrial waste collection systems, though similar in nature, are covered by other criteria and should be addressed on an individual basis.

3.2 DESIGN REQUIREMENTS: Consideration must be given to the capacity of the existing sanitary sewer collection system to identify a suitable point of connection. When anticipated flows are minimal (less than 1,900 liters per day (500 gallons per day (gpd))), an analysis of the existing sewer capacity is not necessary. For flows greater than 1,900 lpd (500 gpd), existing sewer capacity must be determined. This information shall be obtained from field measurements (flow testing) by the Design-Build Contractor's Architect/Engineer of Record.

3.3 SIZING OF SANITARY SEWER LINES: No sewer mains shall be less than 200 mm (8 in) in diameter. Service connections for single family dwellings or equivalent (approximately 1,900 lpd (500 gpd)) shall be at least 100 mm (4 in) in diameter. All other building service connections shall be at least 150 mm (6 in) in diameter. Additional design criteria for gravity sanitary sewers lines are as follows:

- a. **SLOPES:** Design pipe slopes to ensure a velocity of at least 0.75 meter per second (2.5 feet per second (fps)) when pipe is flowing full at peak flow. Velocities as low as 0.60 mps (2.0 fps) when flowing full are permitted where appreciable cost benefits can be realized, subject to approval of the

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SOUTHWESTNAVFACENGCOM Chief Engineer. The velocity should not exceed 3 mps (10 fps) under any circumstances. The following are recommended minimum slopes:

<u>Sewer Size</u>	0.60 mps (2 fps)	0.75 mps (2.5 fps)
	Minimum Slope m/100 m (<u>ft/100 ft</u>)	Minimum Slope m/100 m (<u>ft/100 ft</u>)
100 mm (4 in)**	1.05	1.35
150 mm (6 in)**	0.65	0.85
200 mm (8 in)	0.40	0.54
300 mm (12 in)	0.22	0.33
375 mm (15 in)	0.15	0.23
450 mm (18 in)	0.12	0.18
600 mm (24 in)	0.08	0.125

The pipe diameter and slope shall be selected to obtain greatest practical velocities to minimize settling problems. If the proposed slope is less than the minimum slope, calculations showing actual depths and velocities anticipated shall be provided. Gravity mains shall be laid with uniform slope between manholes.

b. **DESIGN FLOWS:** Use the Manning formula to design sewers to flow three-quarters (3/4) full, under peak wet weather flow. Use a friction factor "n" of 0.013. Use per capita sewage flow rates as determined by the local sewer agency or appropriate NAVFAC design manuals.

c. **DEPTH:** Design all sewers to maintain the minimum cover required to protect the structural integrity of the pipe. Any pipes with less than 0.6 m (2 ft) of cover shall be ductile iron pipe (ASTM A746).

3.4 MATERIAL SELECTION

3.4.1 GRAVITY SEWER LINES: For most installations, sewer mains and service connections shall be either ductile iron pipe (ASTM A746), PVC pipe (ASTM D3034, SDR 35), or ABS plastic pipe (ASTM D2751 or ASTM D2680). Other materials may be appropriate on certain projects and should be evaluated on a case by case basis. SOUTHWESTNAVFACENGCOM, Chief Engineer approval shall be obtained before materials other than those listed are specified or installed.

3.4.2 SEWER FORCE MAINS: For most installations, sewer force mains 4 inches in diameter and larger shall be either ductile iron pipe (AWWA C151) or PVC pipe (AWWA C900). Force mains smaller than 4 inches in diameter shall be PVC Class 315 (ASTM D-2241) with bell and spigot joints; no solvent welded joints shall be used.

3.5 SYSTEM LAYOUT: All sewer lines shall be laid with straight alignment between manholes and/or cleanouts. Curvilinear alignment of sewer lines is not acceptable. The maximum spacing between manholes shall be 120 m (400 ft). Any change in direction or slope requires a manhole. For service connections (100 mm & 150 mm (4 & 6 inches in diameter)), where a change in slope and/or direction occurs, the manhole may be replaced by a cleanout, provided that the length of service line down stream of the cleanout is not longer than 45 m (150 ft). In locating sewer lines and manholes consider the following as minimum

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guidelines and comply with the requirements of the local health department regarding water and sewer separation:

- a. Sewer lines shall be clear of all structures, adjacent to and parallel to streets, and where possible, the manholes shall be located out of roadways and paved areas.
- b. Sewer lines shall be laid in trenches separate from water lines, and below and at least 3 m (10 ft) away from nearby water lines, preferably on opposite sides of the street.

3.6 MANHOLES: The minimum diameter of manholes shall be 1,200 mm (48 in); larger diameters shall be required for large diameter sewers. Manhole steps shall be provided in accordance with AWWA C478.

3.6.1 DROP MANHOLES: Drop manholes shall be provided for any manhole where the difference between the inlet pipe invert elevation and the manhole invert elevation is greater than 600 mm (24 in). The entire outside drop connection shall be encased in concrete.

3.6.2 FLOW CHANNEL: The flow channel through the manhole shall be made to conform as closely as possible to the shape and slope of the connecting sewers. Whenever connections are made to existing manholes, the bench of the manhole shall be re-worked to provide proper flow channels. Flow from inlet pipes should never enter in the opposite direction to the flow in the manhole.

3.7 LIFT STATIONS: Use sewage lift stations only where specifically identified in the project scope of work or upon written approval from the Contracting Officer. Consider pumping only where a gravity system cannot serve hydraulically or where cost analysis shows a significant savings. In addition to coordinating with the applicable regulatory and permitting agency and base Public Works Officer, adhere to the following criteria:

- a. Provide two pumps, each sized to handle 1.3 times the peak flow, for most installations.
- b. Pumps shall be capable of passing 80 mm (3 in) solids. For small installations (less than 950 lpm (250 gpm)) pumps capable of passing 65 mm (2-1/2 in) solids are acceptable when the pumps are preceded by a bar screen; consider using grinder pumps to eliminate the need for a bar screen.
- c. Pump stations must have adequate ventilation and lighting, and provide for personnel access.
- d. All lift stations shall have high level alarms that are both audible and visible. Alarm relays shall be connected to the Public Works Emergency Duty Desk or other 24-hour manned station designated by the Activity Public Works Officer.
- e. Provide wetwells constructed of pre-cast concrete cylinder rings with embedded PVC-lining (T-Lock).

3.8 FORCE MAINS: Force mains should be kept as short as possible. Maintain a minimum velocity of 0.9 mps (3 fps). Velocities should not exceed 3.0 mps (10 fps). All force mains should have a minimum of 1.0 m (3 ft) of cover. Provide adequate thrust restraint.

END OF SECTION